BRINGING INNOVATIVE TECHNOLOGIES TO THE D&D MARKETPLACE

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ABSTRACT

The Deactivation and Decommissioning Focus Area (DDFA) in the U.S. Department of Energy's (DOE) Office of Science and Technology has been demonstrating and deploying innovative and improved decontamination and decommissioning (D&D) technologies through its Large-Scale Demonstration and Deployment Projects (LSDDP). In LSDDPs, innovative and improved D&D technologies are demonstrated alongside the competing baseline technologies as part of DOE's active deactivation and decommissioning projects. Performance data is collected on both the innovative and baseline technology to assist project planners in deciding whether to incorporate the innovative technology into their baseline D&D project(s). The success of the LSDDPs is measured by the number of innovative technologies that are deployed in deactivation and decommissioning projects within the DOE weapons complex following successful demonstrations, and the quantifiable benefits that the innovative technologies bring to those projects in terms of cost saving, radiation dose reduction, waste volume reduction, schedule acceleration, and safety improvements. The DDFA has started seven LSDDPs which include projects at Argonne National Laboratory, Fernald Environmental Management Project, Hanford Reservation, Los Alamos National Laboratory, Idaho National Engineering and Environmental Laboratory, Savannah River Site, and Mound Environmental Management Project.

I. THE LSDDP CONCEPT

An Integrating Contractor (IC) Team manages the technology demonstration aspects for each of the LSDDPs. Typically, three or more experienced D&D firms will comprise the IC Team in addition to participation by the site management and operating (M&O) or management and integration (M&I) contractor. Often, technology vendors, technology brokers, academia, nuclear utilities, and regulators participate on the IC Team. Typically, no more than six organizations comprise an IC Team. The D&D firms on the IC Team are expected to bid and use successful innovative technologies on future deactivation or decommissioning projects at other DOE sites and commercial nuclear facilities.

The IC Team responsibilities include identification of baseline technologies and its performance specifications; identification of the project's technology needs; identification of technology evaluation criteria; screening and selection of innovative technologies; contracting with technology vendors; development of test plans for demonstration of innovative and baseline technologies; integration of demonstration activities into the baseline D&D project; collection of demonstration data; innovative and baseline technology evaluation and reporting; and technology transfer. An innovative or improved D&D technology is considered suitable for demonstration in an LSDDP if it is a technology under development that has reached the full-scale development stage; a new application of an existing technology; or a commercial technology that has not been deployed within DOE.

The cost of a LSDDP is shared by the DDFA and the owner of the surplus DOE facility who also share oversight management of the IC Team. The vendors of innovative technologies are also expected to share in the cost of their demonstration in return for a rapid avenue to commercialization and acceptance by the end users, regulators, and other stakeholders.

Through an interagency agreement, the DDFA has acquired the services of the U.S. Army Corps of Engineers (USACE) to conduct uniform and unbiased cost analysis of all technologies demonstrated in all LSDDPs. The USACE is involved in developing the test plan to ensure that its data collection requirements are included in the test plan.

Effective communication of demonstration results is the most critical aspect of the LSDDP. Communication approaches used by the IC Teams includes preparation of an Innovative Technology Summary Report for each technology demonstration which includes cost and other performance data; factsheets distributed within two weeks after a demonstration to provide preliminary results; LSDDP websites; DDFA website; conference papers and presentations, and open houses with live technology demonstrations. The DDFA website is http://www.wpi.org/doe/focus/dd.

II. LARGE-SCALE DEMONSTRATION AND DEPLOYMENT PROJECTS

The DDFA has three ongoing LSDDPs that will be completed in FY98, and is starting four new LSDDPs in FY98. The three LSDDPs ending in FY98 are the Chicago Pile 5 Research Reactor at Argonne National Laboratory-East; Plant 1 at the Fernald Environmental Management Project; and the 105-C Production Reactor at Hanford. The four new LSDDPs are the Transuranic Waste Characterization, Decontamination, and Disposition LSDDP at Los Alamos National Laboratory; the Fuel Storage Canals and Associated Underwater and Underground Facilities LSDDP at the Idaho National Engineering and Environmental Laboratory; the Tritium Facilities LSDDP at Mound Environmental Management Project; and the 321-M Fuel Fabrication Facility LSDDP at Savannah River Site.

A. Chicago Pile 5 Research Reactor LSDDP

The first LSDDP was the Chicago Pile 5 (CP-5) Research Reactor Facility at Argonne National Laboratory - East. This LSDDP focused on the removal of equipment from the reactor facility and decontamination of the facility for subsequent reuse. The CP-5 reactor is a heavy-water moderated and cooled, highly-enriched uranium-fueled thermal reactor designed to supply neutrons for research. The CP-5 reactor had a thermal power rating of five megawatts and was operated almost continuously for 25 years until its final shutdown in 1979 when the fuel rods were removed from the reactor and the heavy water was drained from the system.

The major work activities accomplished during the CP-5 LSDDP include removal of the reactor internals and biological shield, decontamination of fuel rod storage area, hot cell decontamination, decontamination of the fuel pool water and structure, and decontamination of the reactor building including material storage and handling areas. Twenty-two technologies were demonstrated in the CP-5 LSDDP.

B. Fernald Plant 1 Uranium Processing Facility LSDDP

The second LSDDP is at the Fernald Environmental Management Project (FEMP) Site and is focused on the decontamination and dismantlement of the Plant 1 complex. The Plant 1 complex is part of the former Uranium Feed Materials Production Facility and consists of Building 1A which is a large, radioactively contaminated, multi-story, process facility containing asbestos insulation, transite wall paneling, large process equipment, and utilities. Building 1A was used to receive all enriched-uranium materials that were processed at Fernald. Additionally, non-enriched ore concentrates and recycled materials were weighed, sampled, and milled in this plant prior to distribution to other process facilities. Activities to be accomplished during this LSDDP include the decontamination and dismantlement of the buildings and their contents. The D&D of Plant-1 is one of more than 20 work packages of similar scope at the FEMP Site. Thirteen technologies will be demonstrated in the FEMP Plant 1 LSDDP.

C. Hanford 105-C Reactor LSDDP

The third LSDDP is the 105-C Reactor Interim Safe Storage Project. The C Reactor, located within DOE's Hanford Reservation on the south bank of the Columbia River, is a full-scale weapons material production reactor. The reactor was built in 1952 and shutdown in 1969. The scope of this LSDDP is to place the 105-C Reactor facility in a low-cost, safe-storage condition for up to 75 years pending its final disposal. Activities include demolition and removal of the 105-C building structure around the reactor block and removal of the fuel storage basin.

The Interim Safe Storage Project will reduce the footprint of the 105-C Reactor facility by about 70 percent and significantly reduce future annual surveillance and maintenance costs.

There are 14 full-scale production reactors within the DOE Weapons Complex; five at the Savannah River Site and nine at the Hanford Site. These reactors stand to benefit from the 105-C Reactor work since the safe-storage concept is a low-cost, environmentally conscious, and practical alternative to immediate full-scale reactor building dismantlement. Commercial nuclear facilities as well as other contaminated DOE facilities, such as canyons and gaseous diffusion plants will also benefit from technologies demonstrated at the 105-C Reactor. A minimum of twenty technologies will be demonstrated in the 105-C Reactor LSDDP.

D. INEEL Fuel Storage Canals and Associated Underwater and Underground Facilities LSDDP

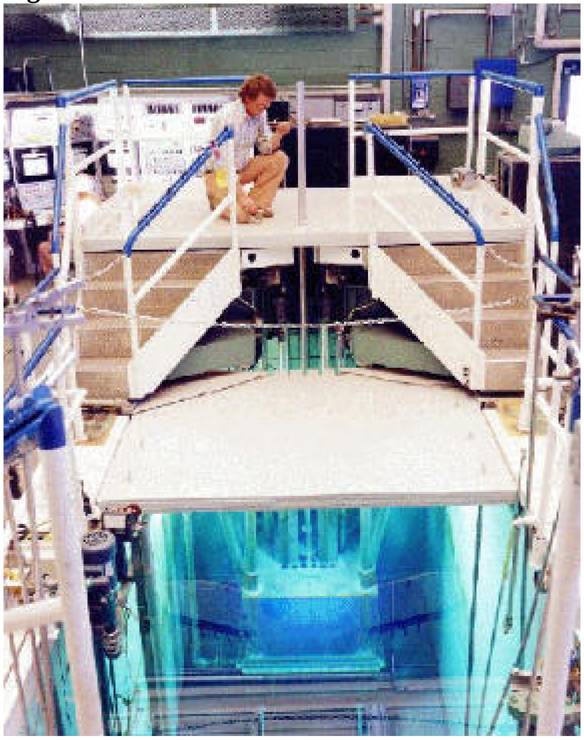
The LSDDP at the Idaho National Engineering and Environmental Laboratory involves decommissioning of Fuel Storage Canals and Associated Underwater and Underground Facilities. Specifically, the LSDDP will include two underwater reactors which are the Advanced Reactor Material Facility (see Figure 1) and Coupled Fast Reactivity Measurement Facility with interconnecting water canal in Test Reactor Area (TRA) 660; TRA Filter Pits in buildings 655, 704, 705, 706 which are located underground in confined space entry pits; and the Initial Engine Test Control Room in Test Area North 620. Sixteen to eighteen improved and innovative technologies will be demonstrated in the project. The project began on March 1, 1998 and it will be completed in March, 2000.

The top of the active core for each pool-type reactor is about 12 feet below the surface of the water. The 30,000-gallon water canal was used for fuel storage and is 8 feet wide, 28 feet long, and 18 feet deep. The 66 fuel elements have been removed from the canal. In addition to radioactive elements, contamination includes lead and chromium.

The TRA Filter Pit System consists of five buildings containing large filters associated with reactor operations. The filters are mostly underground in very confined space entry pits. The main contaminants are lead, radionuclides, and deteriorating asbestos.

The Initial Engine Test Control Room is a massive underground, shielded, reinforced, concrete structure. It was used as the control center for the Aircraft Nuclear Engine tests in the Aircraft Nuclear Propulsion Program. It is contaminated with lead, mercury, asbestos, and potentially radionuclides.

Figure 1. ARMF Reactor at INEEL

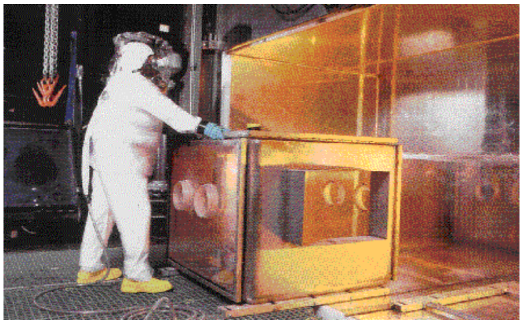


E. LANL TRU Waste Characterization, Decontamination, and Disposition LSDDP

Los Alamos National Laboratory (LANL) has about 2,400 cubic meters of large metallic transuranic (TRU) waste in retrievable storage at TA-54, Area G, which is LANL's Solid Waste Operations Facility. This TRU waste resulted from surplus gloveboxes used for handling plutonium (see Figure 2). LANL was awarded an Accelerated Site Technology Deployment project which will enable them to purchase and install a Decontamination and Volume Reduction System (DVRS) from Nuclear Fuel Services, Inc. in Dome 226. In early 1999, LANL will begin to process its metallic TRU waste using the DVRS as its new baseline technology.

The DVRS is comprised of a modular enclosure, an ultra-high pressure (i.e, 40,000 psi) water jet decontamination cell, a high-capacity shear baler, a five-station non-destructive assay system, and a WasteMover™ computerized material control and tracking system. The 16-inch bales of variable thickness compacted by the shear baler are combined by the WasteMover™ system according to their volume and curie content. The DVRS will reduce radiation dose to workers, reduce volume of TRU waste by 93%, and reduce the TRU waste management schedule at LANL from 17 to 6 years. The DVRS will be able to process about six cubic meters of TRU waste per day.

Figure 2. D&D of Plutonium-contaminated Glovebox at LANL

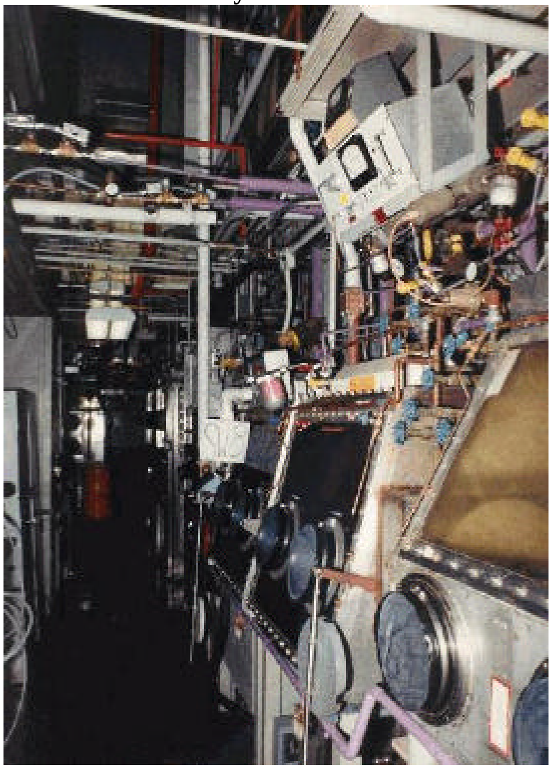


The LANL LSDDP will demonstrate 10-12 innovative and improved technologies competing directly with technology components of the DVRS. The LANL LSDDP began on March 1, 1998 and will be completed in September, 2000.

F. Mound Tritium Facilities LSDDP

The Mound Tritium Facilities LSDDP involves demonstration of 20 -25 improved and innovative technologies during decommissioning of over 1,000 linear feet of tritium gloveboxes (see Figure 3), fume hoods, miles of process piping, and other tritiated components in laboratory areas of T, SW/R, and HH buildings. These buildings occupy 275,000 square feet of floor space and over 400 tritium laboratories. The T building is a heavily-reinforced underground concrete structure which was used to purify Polonium-210 used in nuclear weapons initiators, extract other radionuclides, and store transuranic materials. Since 1980, the Tritium Emissions Reduction Facility, Hydrogen Isotope Separation System, and other multi-kilogram tritium handling facilities were added to T building. The SW/R building is a two-story building used for handling tritium in nuclear weapons programs. The LSDDP began on March 1, 1998 and will conclude in September, 2000.

Figure 3. Glovebox and Process Piping at Mound's SW Facility



G. Savannah River 321-M Fuel Fabrication Facility LSDDP

Savannah River's 321-M fuel fabrication facility (see Figure 4) was used to manufacture fuel and target assemblies for irradiation in the site's production reactors. The process required casting furnaces, extrusion equipment, and associated mechanical equipment. About 1,200 grams of highly-enriched uranium (HEU) remains in the ventilation ducts, processing systems, and other areas of the facility. Removal of HEU contamination will stabilize the 321-M facility and reduce its long-term surveillance and maintenance costs. The LSDDP involves demonstration of 6-10 improved and innovative technologies during stabilization of the 321-M fuel fabrication facility. The LSDDP began on March 1, 1998 and be completed in December, 1999.

As shown in Table 1, the DDFA has co-sponsored LSDDPs with all three of DOE's main site environmental cleanup organizations within DOE's Office of Environmental Management.

Figure 4. SRS 321-M Fuel Fabrication Facility

Table 1. Host Sites and Co-Sponsors for Large-Scale Demonstration and Deployment Projects

DOE/EM Co-Sponsoring Organization	DOE Operations/ Field Office	Site/Facility
EM-30 Waste Management	Albuquerque	LANL Solid Waste Operations Facility
EM-40 Environmental Restoration	Chicago Fernald Richland Idaho Mound	ANL-E CP-5 Research Reactor FEMP Plant 1 Hanford 105-C Reactor INEEL Test Reactor Area Mound Tritium Bldgs. T, SW/R, HH
EM-60 Nuclear Material and Facility Stabilization	Savannah River	SRS 321-M Fuel Fabrication Facility

The IC Teams have not been finalized for the four new LSDDPs. Among the IC Teams for the seven LSDDPs, it is expected that there will be at least 13 different D&D service companies; two nuclear utilities; seven site contractors; two technology developers; five technology brokers; two universities; and one regulatory agency. Some organizations will participate on more than one LSDDP to assist in continuity of the LSDDP concept, but the DDFA has deliberately sought IC Teams with new members to assist in directly transferring innovative D&D technologies to as many organizations as possible. Also, the DDFA has diversified the host sites and types of facilities among the seven LSDDPs, and will be co-managing the LSDDPs with seven different DOE Operations/Field Offices.

III. TECHNOLOGY DEPLOYMENT

Through March, 1998, the first three LSDDPs have demonstrated over 50 innovative technologies in the areas of characterization, decontamination, dismantlement, material disposition, and worker health and safety. Fourteen technologies have been deployed at over 35 sites (see Table 2). Through the LSDDPs, these technologies have demonstrated cost savings and other benefits compared to the baseline D&D technology and are expected to replace the baseline technology for the site. More technology deployments are anticipated from the current set of demonstrations of innovative technologies.

CONCLUSION

The DDFA's Large-Scale Demonstration and Deployment Projects have proven to be an excellent approach to demonstrate and deploy innovative technologies across the DOE weapons complex. We are just beginning to reap the substantial benefits of this approach as confirmed by the successful deployment of numerous innovative technologies following their demonstration in an LSDDP. These technologies have become the new baseline technology for the site, and set a new performance standard for competing technologies and approaches. Other benefits which are unique to this approach include:

- Direct transfer of innovative technologies to experienced D&D firms
- Demonstration of multiple innovative technologies
- in an active D&D project
- Side-by-side comparison of baseline and innovative technologies
- Independent analysis of cost and other performance factors
- Demonstration of technologies outside of EM-50's technology development program
- Scale, scope, and duration of the technology demonstrations is defined by the end user
- Opportunities for technology vendors to immediately deploy technologies following successful technology demonstrations
- Technology demonstrations assist the DOE site in decommissioning its facility because the demonstrations occur in an active D&D project

Table 2. Deployed Innovative Improved D&D Technologies

Name of Technology	Application	Deployment Location
Dual Arm Work Platform	Control rod sizing	Argonne National Laboratory
Swing Reduced Crane	Material handling	Argonne National Laboratory
Rosie Mobile Work System	Reactor dismantlement, and waste handling and packaging	Argonne National Laboratory
Centrifugal Shot Blast	Concrete decontamination	NRC plutonium-uranium facility
GammaCam	Shield placement and detection of "hot spots"	Argonne National Laboratory Hanford Wolf Creek Nuclear Peach Bottom Atomic Power Station Limerick Generating Station Arkansas Nuclear One
Pipe Crawler	Interior pipe inspection	Park Township Site
Pipe Explorer	Interior pipe inspection	Mound PG&E Trojan Nuclear Plant FP&L Crystal River Nuclear Plant
Oxy-Gasoline Torch	Metal cutting	Pantex Argonne National Laboratory Oak Ridge Laquila Fernald Hanford Reactive Metals Inc. Russia Kazakhstan
VecLoader HEPA VAC	Insulation removal	Fernald
Heat Stress Monitoring System	Worker protection	Hanford
STREAM (System for Tracking, Remediation, Engineering, Activities, and Materials)	D&D planning and project management software	Savannah River Chernobyl Hanford
Mobile Integrated Temporary Utility System	Portable power, light, safety, alarm, and communication system	Hanford
Laser Assisted Ranging and Data System	Indoor alpha and beta characterization	Hanford
Surface Contamination Monitor	Free release surveys	Hanford Argonne National Laboratory BONUS Reactor in Puerto Rico Idaho National Engineering and Environmental Lab Connecticut Yankee Oak Ridge Institute for Science and Education

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